

STUDIES ON ECOLOGICAL PREREQUISITES FOR GROWTH OF *PINELLIA TERNATA*

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Abstract Results of the present paper show that the normal growth of *Pinellia ternata* requires the following three ecological prerequisites: warm climate (suitable temperature is 10~27°C), higher soil humidity (suitable moisture content of the soil is about 20~22%) and diffuse sunlight (light intensity is 3000 to 30000 lx). However, bright light, higher temperature (>35°C) and water - logging are harmful to its growth.

Key words *Pinellia ternata*, ecological prerequisites, temperature, soil humidity, light intensity.

INTRODUCTION

Pinellia ternata (Thunb.) Breit (Araceae) is a perennial herb distributed widely in East Asia, especially in the Yangtze River Valley. The tuber of *Pinellia ternata* has been an important herbal drug in traditional Chinese medicine. However, because of excessive utilization of the tuber and the change of cropping system, especially the rotation of dry and water crops, as well as the application of herbicides in farming land, wild resources of *P. ternata* have decreased rapidly in recent years. Thus, it is essential to introduce and cultivate *P. ternata* and to study the ecological prerequisites for its growth.

This paper introduces three ecological prerequisites for the normal growth of *P. ternata*: temperature, soil humidity and light intensity.

MATERIALS AND METHODS

1. Materials

Fourteen wild populations of *P. ternata* originating from Jiangsu and Shandong Provinces have been collected and cultivated at Weigang Experimental Farm of Nanjing Agricultural University from March 5 to November 20 in 1987 (Table 1).

2. Methods

All experiments were conducted on yellow clay soil in Weigang Experimental Farm of Nanjing Agricultural University.

(1) Shading Experiments

The tubers of *Pinellia* from Siyang County were planted from north to south in seven - row plots, 4 m long and 1.3 m wide, with space of $15 \times 5 \text{ cm}^2$. Shade intensity was adjusted using different numbers of reed layers, with zero, one, two and three layers as the four treatment. Shading sheds are 70 cm above ground. Each treatment was arranged in a randomized block with three replications.

(2) Intercropping Experiments

The plots were arranged as in Experiment (1). Two rows of maize were intercropped to provide shade along two sides of the plots and no intercropping was done in the control with three replications. The temperature, soil humidity and light intensity were observed during the growth of *Pinellia*.

Table 1. Leaf type and origin of 14 wild populations of *Pinellia ternata*

Leaf Type	Origin (County or City)
Willow leaf type	Fengxian, Xinjing, Heze
Peach leaf type	Pixian, Xiangshui, Yuncheng, Yimeng, Siyang, Kunshan, Rugao, Dongtai, Taixiang
Apricot leaf type	Yizheng, Nantong

(3) Humidity Experiments

The design of plots was the same as in Experiment (1). There were, however, no shading and intercropping, and the tubers of *Pinellia* from Fengxian County. In the four treatments the plots were watered with 0, 2, 4 and 8 kg/m² at 16:00 every day. Each treatment was arranged in a randomized block with 3 replications.

RESULTS AND DISCUSSION

The results show that the life cycle of wild population of *P. ternata* and experimental field is closely related to ecological prerequisites such as temperature, soil humidity, and light intensity.

The tubers of wild *Pinellia* germinate from the middle to late March and emerge in early April. The plants of *Pinellia* grow luxuriantly from the middle of April to early July. "Sprout tumble" for the majority of plants over - summer except in the shade of trees, grass and intercropping develop in the middle July to the middle August. In the early September, the tubers germinate and the plants grow again until dormancy to over - winter in middle November.

1. Effect of Temperature on Growth of *Pinellia ternata*

The growth of *P. ternata* is related to the variation of temperature (Figure 1). From late March to early April, the tuber of *Pinellia* begin to emerge easily when average temperature is about 10°C in a period of ten days. It is starting point temperature for *Pinellia* to grow. From the middle of April to early July, *Pinellia* grow luxuriantly when average temperature is about 15 to 27°C, in a period of ten days. Since the middle July, "sprout tumble" occurs gradually in large scale when the temperature rises to over 35°C at the end of monsoon. In autumn, the tubers germinate and the plants grow again when the temperature decreases to below 27°C until "sprout tumble". They are dormant and over - winter from early to middle November when temperature drops to below 10°C.

Because the environmental conditions such as temperature, light and humidity in spring were more suitable than that in autumn, the growth of *Pinellia* in spring is better than in autumn. There are more than 180,000 seedlings/mu in spring, but about 100,000 seedlings/mu in autumn (1 mu = 1/15 ha). This result is similar to the reports of Zhang (1986), Wang (1986) and Guo (1993).

2. Effect of Light Intensity on Growth of *Pinellia ternata*

The light intensity on sunny days was about 90,000 lx in the shading experiments at 12:00 of August 1. If the light intensity is too high, *Pinellia* will not tolerate and "sprout tumble" of all plants of *Pinellia* occur. However, if the light intensity is too low, the plants will grow unhealthily and "sprout tumble" of most plants occurs (Table 2).

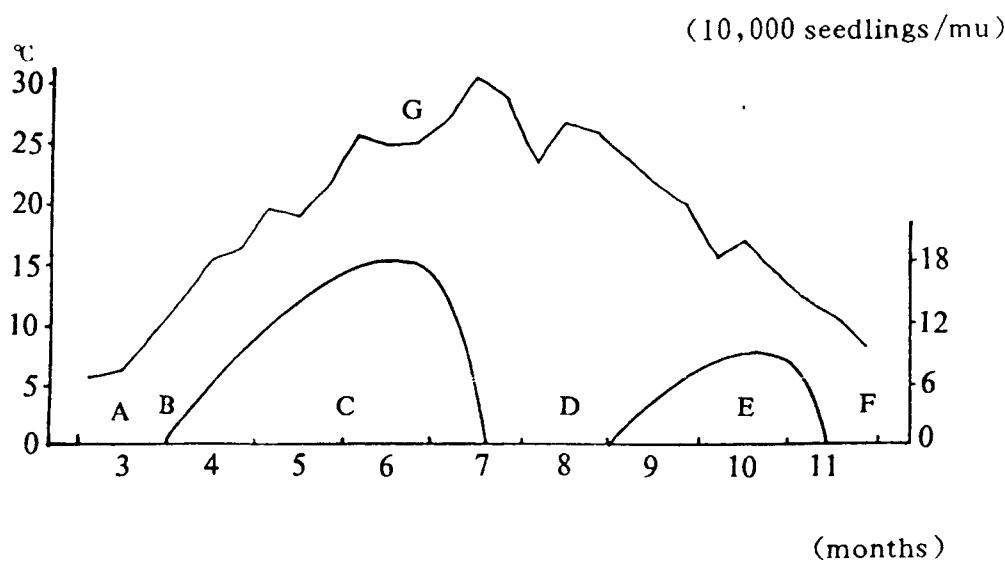


Fig. 1. Effect of temperature on growth of *Pinellia ternata* in Nanjing Region

- A. Germination;
- B. Emergence;
- C. Grow luxuriantly;
- D. "Sprout tumble" to over - summer;
- E. Growth in autumn;
- F. "Sprout tumble" to over - winter;
- G. Temperature curve

Table 2. Effect of shading on growth of *Pinellia ternata*

Treatments	Light intensity (lx)	Rate of "sprout tumble" (%)
One layer of reed	16000	85
Two layers of reed	3000	98
Three layers of reed	1000	100
CK (no shed)	90000	100

As shown in Table 3, intercropping with maize is advantageous to the growth of *Pinellia*. The light intensity is reduced by about 50% as compared with that of the control in the morning or afternoon, which can meet the light requirement of *Pinellia*. The light intensity is reduced by about 75% as compared with that of the control at noon, which is effective to protect the plants from injury resulting from high light intensity. The rate of "sprout tumble" is about 50% as compared with the control.

Table 3. Effect of intercropping on growth of *Pinellia ternata*

Treatments	Light intensity (lx)			eighth of plants (cm)	Rate of "sprout tumble" (%)	Fresh weight of tubers (g)
	Morning	Noon	Afternoon			
Intercropped	3000	26000	6000	20.9	48	2.08
Control	6500	100000	13000	17.3	93	2.13

The results show that the plants of *Pinellia* can grow normally under 30,000 Lux of light intensity in summer.

3. Effect of Soil Humidity on Growth of *Pinellia ternata*

As shown in Table 4, the temperature in the soil (5 cm depth) of watering plots decreased by 1.1 to

2.4°C. The water holding capacity in soil increased from 0.7 to 5.7%, the rate of "sprout tumble" is about 50% and the total yield increased from 6.4 to 42.9% as compared with that of the control. Otherwise, water can drop in temperature, which is very important to reduce "sprout tumble". However, if the water holding capacity in the soil is over 22% or waterlogging, the yield will be reduced with the rotting roots or tubers. This is the main factor that wild resources of *P. ternata* growing in farming fields has been reduced rapidly since the rotation of dry and irrigated crops, e.g. the rotation of rice and wheat in the Yangtze River valley.

Table 4. Effect of Watering on Growth of *Pinellia ternata*

Treatments		I	II	III	IV
Capacity of watering (kg/m ²)		0	2	4	8
Containing water in soil (kg/m ²)		18.6	19.3	21.3	23.8
Temperature in soil (depth 5cm, °C)		32.6	31.5	30.9	30.2
Rate of "sprout tumble" (%)	May 29	15.0	3.0	1.8	1.0
	June 5	10.0	5.0	3.5	2.0
Number of leaves per plant		1.9	2.8	2.5	3.7
Bulbul yield (kg/mu)		77.0	89.8	99.1	79.5
Tuber yield (kg/mu)		437.7	478.2	636.5	468.3
Total yield (kg/mu)		514.7	568.0	735.6	547.8
	rate of increase (%)	0	10.4	42.9	6.4

(2) Drilling Fluid

Zeng (1989) researched the application of KGM gum as a non-clay drilling fluid. The results showed that it is especially suitable for diamond drilling, drilling for all kinds of downhole motor, hydrogeology and wheat in the Yangtze River Valley.

CONCLUSIONS

1. *Pinellia ternata* grows well in the warm environment. Its growth starting temperature is about 10°C, the suitable one being 10 to 27°C. When the temperature is over 27°C, the plants grow slowly and the "sprout tumble" appears, if above 35°C all plants tumble to over-summer with tuber dormancy.

2. *P. ternata* is a kind of shade-enduring but shade-loving plant. The suitable light intensity is 3000 to 30000 lx for *Pinellia* to grow normally.

3. Higher soil humidity is one of the most important ecological prerequisites for *Pinellia* to grow well. However, when the containing water in the soil is over 22% or water-logging, the yield will be reduced and roots or tubers will rot.

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